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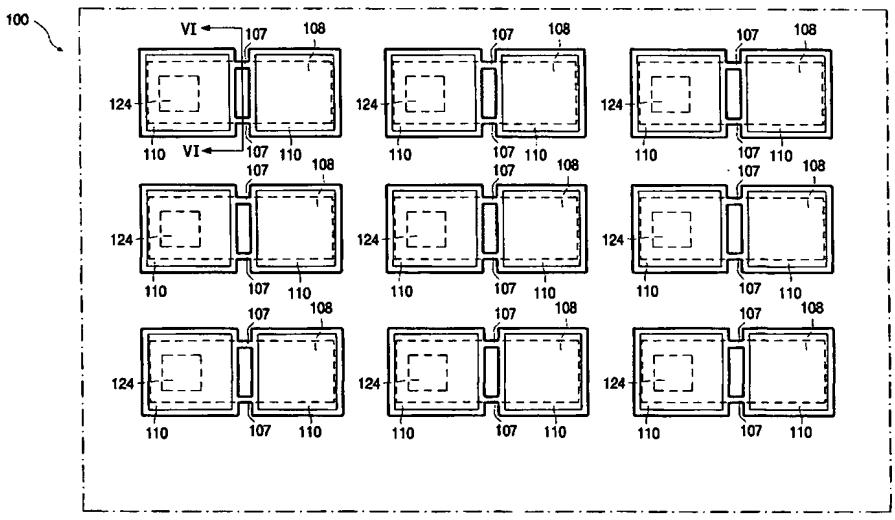
[Continued on next page]

(54) Title: ELECTRIC DEVICE COMPRISING A LAYER OF PHASE CHANGE MATERIAL AND METHOD OF MANUFACTURING THE SAME



(57) Abstract: The electric device (100) has a body (102) having a resistor (107) comprising a phase change material being changeable between a first phase and a second phase. The resistor (107) has a first electrical resistance when the phase change material is in the first phase, and a second electrical resistance, different from the first electrical resistance, when the phase change material is in the second phase. The phase change material constitutes a conductive path between a first contact area and a second contact area. A cross-section of the conductive path is smaller than the first contact area (124) and the second contact (132) area. The body (102) may further have a heating element 106 being able to conduct a current for enabling a transition from the first phase to the second phase. The heating element (106) is preferably arranged in parallel with the resistor (107).

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SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 03/05734

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L45/00 H01L27/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01L G11C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 789 758 A (REINBERG ALAN R) 4 August 1998 (1998-08-04) column 3, line 15 - column 6, line 61 claim 1 figures 2,5	1 2,8,9
Y	US 5 534 712 A (KLERSY PATRICK ET AL) 9 July 1996 (1996-07-09) column 15, lines 36-56 column 25, lines 25-34	2
Y	WO 00/57498 A (ENERGY CONVERSION DEVICES INC) 28 September 2000 (2000-09-28) page 8, line 24 - page 12, line 14 figure 2	8,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 June 2004	20.08.2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Meul, H

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 03/05734

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4 ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-2, 8-12

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-2, 8-12

Electric device comprising a resistive layer of phase change material having a reduced cross section of the conductive path in the layer between two contact areas.
The document US 5,789,758 A (=D1) discloses a memory cell comprising upper and lower layers of a chalcogenide material contacted with carbon/molybdenum electrodes and sandwiching a volume of said chalcogenide material within a pore in a dielectric layer, a cross section of the pore portion being lower than the cross sections of both of the chalcogenide layers (see Fig. 2 and the related text as well as claim 1 of D1).
When comparing the present application with D1, one can identify the formation of the constricted conductive path in the chalcogenide layer as the special technical feature of the first invention according to Rule 13 (2) PCT.
The problem to be solved by the first invention may therefore be regarded as to facilitate the fabrication of the phase change device having improved endurance.

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2. claims: 3-7

Electric device comprising a resistor of a phase change material and a heating element. The heating element allows for a more efficient use of the electric energy when inducing a phase transition in the phase change material.
D1 does not disclose an additional heating element which is identified as the special technical feature of the second invention according to Rule 13 (2) PCT.

INTERNATIONAL SEARCH REPORT

International Application No
/IB 03/05734

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